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Using ionospheric scintillation indices to estimate GPS receiver tracking performance

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The Institute of Engineering Surveying and Space Geodesy (IESSG), at the University of Nottingham, has been involved with ionospheric scintillation research and its impact on users of Global Navigation Satellite Systems (GNSS) since 2001. The IESSG hosts a comprehensive archive of scintillation data recorded during the last high of the solar cycle (2001-2003) by four GSV4004 receivers (GPS Silicon Valley) in the UK and Norway, at geographic latitudes varying from 53N to 71N. The scintillation data that forms this $\sim$3–year archive is given solely by the widely used scintillation indices S4 and $\sigma\varphi$ (in particular the latter's 60 second version). Aquino et al (2007) describe a strategy devised to enable the combination of these scintillation indices and the spectral parameters T (the spectral strength of the phase noise at 1 Hz) and p (the spectral slope), extracted from high-rate GPS phase and amplitude data, with state-of-the-art receiver tracking models in order to study receiver tracking performance under scintillation conditions. Strangeways (2009) later devised a method to calculate the scintillation parameters T and p over a range of Fresnel frequencies based only on the scintillation indices, i.e. when high rate data is not available, as in the case of the IESSG archive of 2001-2003.
This paper shows initial investigations on the retrieval of the spectral parameters p and T from actual GPS scintillation indices recorded more recently in Trondheim (app. Lat 64N, Long 10E) on 23 April 2008. T and p values are estimated from S4 and $\sigma\varphi$ and compared with actual spectral parameters obtained from high rate data that are now being recorded. The paper then takes investigations a step further, by comparing the output of a state of the art tracking model when the estimated and actual spectral parameters are used as input, respectively. This paper gives an initial insight on the applicability of the method to mitigate the effects of the ionospheric scintillation on receiver tracking performance.